

NON-PUBLIC?: N  
ACCESSION #: 9312090060  
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Palo Verde Unit 2 PAGE: 1 OF 08

DOCKET NUMBER: 05000529

TITLE: Reactor Trip and Auxiliary Feedwater Actuation Signals  
Following Degraded Voltage on non-Class IE 4160V Bus  
EVENT DATE: 11/01/93 LER #: 93-004-00 REPORT DATE: 11/25/93

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 085

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR  
SECTION:  
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:  
NAME: Burton A. Grabo, Nuclear Regulatory TELEPHONE: (602) 393-6492  
Affairs, Supervisor

COMPONENT FAILURE DESCRIPTION:  
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:  
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

#### ABSTRACT:

On November 1, 1993, at approximately 0807 MST, Palo Verde Unit 2 was in Mode 1 (POWER OPERATION), operating at a approximately 85 percent steady-state power, when a reactor power cutback to approximately 45 percent power occurred following the loss of a main feedwater pump (MFWP), and at approximately 0808 MST, a reactor trip occurred on low steam generator water level. The reactor trip was initiated by a non-Class 1E 4.16 kV switchgear bus load shed which caused the loss of two condensate pumps and a heater drain pump. Both MFWPs tripped on low suction pressure. Immediately following the reactor trip, the SG-2 water level reached the RPS trip setpoint for low steam generator water level, followed by the Engineered Safety Feature Actuation System (ESFAS) actuation of both Auxiliary Feedwater Actuation Systems (AFAS-1 and AFAS-2) on low-low steam generator water level for both steam generators. Per design, the AFAS signals automatically started the Train A and Train

B Emergency Diesel Generators. The steam generator water levels were restored using auxiliary feedwater. By approximately 0830 MST on November 1, 1993, the plant was stabilized in Mode 3 (HOT STANDBY) and the event was diagnosed as an uncomplicated reactor trip. No other safety system responses occurred and none were required. All plant equipment responded as designed.

The NBN-S01 load shed was caused by an insufficient electrical contact in a potential transformer (PT). The PT was adjusted and returned to service.

There have been no previous similar events reported pursuant to 10CFR50.73.

END OF ABSTRACT

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## I. DESCRIPTION OF WHAT OCCURRED:

### A. Initial Conditions:

At 0807 MST on November 1, 1993, Palo Verde Unit 2 was in Mode 1 (POWER OPERATION) operating at approximately 85 percent steady-state power, when a reactor power cutback to approximately 45 percent power occurred following the loss of a main feedwater pump (MFWP).

### B. Reportable Event Description (Including Dates and Approximate Times of Major Occurrences):

Event Classification: An event that resulted in the automatic actuation of an Engineered Safety Feature (ESF) (JE), including the Reactor Protection System (RPS) (JC).

At approximately 0808 MST on November 1, 1993, a reactor (AC) trip occurred when Steam Generator Number 1 (SG-1) (AB) water level reached the Reactor Protection System (RPS) trip setpoint for low steam generator water level following the loss of the Main Feedwater Pump (SJ)(P) (MFWP) B and MFWP A and a reactor power cutback to approximately 45 percent power. The reactor trip was initiated by a non-Class 1E 4.16 kV switchgear bus load shed which caused the loss of two condensate pumps and a heater drain pump. Both MFWPs tripped on low suction pressure.

Immediately following the reactor trip, the SG-2 water level reached the RPS trip setpoint for low steam generator water level, followed by the Engineered Safety Feature Actuation System (ESFAS) actuation of both Auxiliary Feedwater Actuation Systems (AFAS-1 and AFAS-2) (JE)(BA) on low-low steam generator water level for both steam generators. Per design, the AFAS signals automatically started the Train A and Train B Emergency Diesel Generators (EK). The steam generator water levels were restored using auxiliary feedwater. By approximately 0830 MST on November 1, 1993, the plant was stabilized in Mode 3 (HOT STANDBY) and the Shift Supervisor (utility, licensed) diagnosed the event as an uncomplicated reactor trip. No other safety system responses occurred and none were required. All plant equipment responded as designed.

Prior to the reactor trip, at approximately 0803 MST, numerous non-Class 1E 4.16 kV Switchgear Bus (NBN-S01) trouble alarms were received in the Control Room (NA). An area operator (utility, nonlicensed) was dispatched to investigate the problem with NBN- S01. Control Room personnel (utility, licensed) observed

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fluctuating bus voltage indication. At approximately 0807 MST, NBN-S01 load shed which resulted in the loss of two of three condensate pumps (A and B), heater drain pump B, and other motor loads (i.e., plant cooling water pump A, turbine cooling water pump A, nuclear cooling water pump A, and normal chiller B). As a result, both MFWPs, suction pressure decreased and MFWP B tripped on low suction pressure approximately 11 seconds after the load shed. A reactor power cutback (RPCB) (JD) (i.e., an automatic power reduction) occurred as a result of the MFWP B trip and power was reduced to approximately 45 percent. MFWP A tripped approximately 24 seconds later on low suction pressure. Control Room personnel observed that steam generator water levels were decreasing rapidly. Following an evaluation of plant conditions, the Control Room Supervisor (utility, licensed) directed Control Room personnel to manually trip the reactor. However, before Control Room personnel could complete the reactor trip directive, at approximately 0808 MST, an automatic reactor trip occurred when SG-1 water level reached the RPS trip setpoint for low steam generator water level. All control element assemblies (CEA) (AA) inserted as designed. The reactor trip was followed by a Main Turbine/Main Generator trip. The Steam Bypass Control System (SBCS) (JI)

responded as designed to control the secondary system pressure.

Immediately following the reactor trip, the SG-2 water level reached the RPS trip setpoint for low steam generator water level. At approximately 0810 MST, Control Room personnel started the motor-driven auxiliary feedwater pump (AFB-P01) in order to supply feedwater to the steam generators and to stabilize the plant. However, steam generator levels continued to decrease and at approximately 0811 MST, AFAS-1 and AFAS-2 ESFAS actuations occurred on low-low steam generator water level for both steam generators. The AFAS actuations automatically started the turbine-driven auxiliary pump (AFA-P01) and fully opened the auxiliary feedwater valves to supply a full flow of auxiliary feedwater to both steam generators per design. In addition, the AFAS signal automatically started the Train A and Train B Emergency Diesel Generators per design. The steam generator water levels were restored using auxiliary feedwater. By approximately 0830 MST on November 1, 1993, the plant was stabilized in Mode 3 (HOT STANDBY) at normal temperature and pressure and the Shift Supervisor diagnosed the event as an uncomplicated reactor trip. No other safety system responses occurred and none were required. All plant equipment responded as designed. By approximately 0920 MST on November 1, 1993, the AFAS-1 and AFAS-2 ESFAS actuations were reset and by approximately 1022 MST both emergency diesel generators were secured.

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C. Status of structures, systems, or components that were inoperable at the start of the event that contributed to the event:

Other than the insufficient electrical contact found in the NBN-S01 potential transformer that is discussed in Section I.D, no structures, systems, or components were inoperable at the start of the event which contributed to this event.

D. Cause of each component or system failure, if known:

APS Engineering personnel (utility, nonlicensed) initiated an equipment root cause of failure analysis (ERCFA) to troubleshoot and investigate the cause of the NBN-S01 load shed. NBN-S01 was quarantined to prevent the loss of evidence. Abnormally low bus voltage readings were recorded on two of the three phases (i.e., AB: 1000 VAC; BC: 2800 VAC; and CA: 4160

VAC). Approximately two hours following the event, the load shed relays reset without apparent cause. The APS Engineering evaluation focused on the potential transformer (PT) which provides the voltage input for the load shed relays. With the use of digital fault recorders and a strip chart recorder, APS Engineering personnel determined that the NBN-S01 bus voltage was never lost nor had bus faults or PT fuse breakdowns occurred. The PT drawer (i.e., rollout unit) was jarred and

the load shed condition recurred. As before, the load shed relays reset without apparent cause.

Further testing of the fuses and the PTs was inconclusive in determining the cause of the NBN-S01 load shed. The vendor concluded that the problem was associated with the PT drawer. Reference the figure on Page 8. When the PT drawer was opened, the Phase B secondary movable stab (i.e., spring-loaded finger) was found to be out of alignment with the Phase A and Phase C secondary stabs (i.e., the Phase B stab was not fully extended). The spring on the Phase B stab was not properly seated in the stab's retainer groove. This resulted in insufficient electrical contact between Phase B's secondary stationary and movable stabs. The Phase B insufficient electrical contact accounted for the low voltage readings on two of the three phases (i.e., AB: 1000 VAC; BC: 2800 VAC; and CA: 4160 VAC) and the subsequent load shed of the NBN-S01 bus (the load shed relay is connected between Phase B and Phase C).

No significant evolutions, maintenance, or troubleshooting activities were in progress that contributed to the NBN-S01 load shed. The Phase B secondary stab's spring was replaced, the PT was adjusted, tested, and returned to service.

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E. Failure mode, mechanism, and effect of each failed component, if known:

The failure mode, mechanism, and effect is discussed in Section I.D.

F. For failures of components with multiple functions, list of systems or secondary functions that were also affected:

Not applicable - no failures of components with multiple functions were involved.

G. For a failure that rendered a train of a safety system inoperable, estimated time elapsed from the discovery of the failure until the train was returned to service:

Not applicable - no failures that rendered a train of a safety system inoperable were involved.

H. Method of discovery of each component or system failure or procedural error:

The PT alignment problem was discovered during an investigation immediately following the event. There were no procedural errors which contributed to this event.

A routine Preventive Maintenance (PM) task to clean and inspect the PT drawer was last performed in May 1993. Neither the PM task, PM Basis, nor the Vendor Technical Manual requires the verification of stab alignment, spring placement, or PT drawer alignment.

I. Cause of Event:

An independent investigation of this event (i.e., a reactor trip on low steam generator water level) is being conducted in accordance with the APS Incident Investigation Program. As part of the investigation, an ERCFA of NBN-S01 was performed by APS Engineering personnel. As discussed in Section I.D, the ERCFA has determined that the NBN-S01 load shed was caused by an insufficient electrical contact in a potential transformer (SALP Cause Code E: Component Failure). No other problems were found that could have contributed to the NBN-S01 load shed. No significant evolutions, maintenance, or troubleshooting activities were in progress that contributed to the NBN-S01 load shed. No unusual characteristics of the work location (e.g., noise, heat, poor lighting) directly contributed to this event. There were no personnel or procedural errors which contributed to this event.

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J. Safety System Response:

The following safety systems actuated automatically as a result of the event:

- Emergency Diesel Generators (EK), Trains A and B,
- Essential Spray Pond Systems (BS), Trains A and B,
- Essential Chilled Water System (KM), Trains A and B,
- Essential Cooling Water System (BI), Trains A and B, and
- Essential Auxiliary Feedwater System (BA), Trains A and B.

#### K. Failed Component Information:

The manufacturer of the potential transformer drawer (i.e., rollout unit) is General Electric. The manufacturer's part numbers for the PT drawer range from 733-328X701 through 733-328X718. The spring-loaded secondary movable stab part number is 733-328X715 G1.

## II. ASSESSMENT OF THE SAFETY CONSEQUENCES AND IMPLICATIONS OF THIS EVENT:

A safety limit evaluation was performed as part of the APS Incident Investigation Program. The NBN-S01 load shed did not impact safety related equipment. The evaluation determined that the plant responded as designed, that no safety limits were exceeded, and that the event was bounded by current safety analyses. The impact of the transient posed no threat to fuel integrity as adequate subcooling margin and RCS inventory were maintained throughout the event. There were no Departure from Nucleate Boiling Ratio (DNBR) related fuel failures since the Specified Acceptable Fuel Design Limit (SAFDL) for DNBR was not exceeded during the event. Therefore, there were no adverse safety consequences or implications as a result of this event. This event did not adversely affect the safe operation of the plant or health and safety of the public.

## III. CORRECTIVE ACTION:

### A. Immediate:

The supply breaker associated with NBN-S01 was quarantined to prevent the loss of evidence.

### B. Action to Prevent Recurrence:

The Phase B secondary stab's spring was replaced, the PT was adjusted, tested, and returned to service.

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An independent investigation of this event was conducted in

accordance with the APS Incident Investigation Program. Actions to prevent recurrence were developed based upon the results of the investigation and are being tracked to completion under the PVNGS Commitment Action Tracking System. The actions to date include developing a PM task to include PT secondary contact alignment, inspecting and aligning both the primary and secondary PT stabs in all three units during next scheduled bus outages, and submitting a plant change request to enhance the load shed relay logic to prevent a load shed on a single PT failure.

#### IV. PREVIOUS SIMILAR EVENTS:

Although reactor trips related to the loss of MFWPs have been previously reported, no other previous events have been reported pursuant to 10CFR50.73 where a non-Class 1E 4.16 kV Switchgear Bus load shed caused a reactor trip.

#### V. ADDITIONAL INFORMATION:

Based on reviews by the Plant Review Board (PRB), the Management Response Team, and the APS Incident Investigation Team, unit restart was authorized by the Plant Manager in accordance with approved procedures. Based on PRB approval, the unit was restored to 85 percent power. On November 2, 1993, Unit 2 entered Mode 2 (STARTUP) at approximately 1630 MST and Mode 1 at approximately 2125 MST, and was synchronized on the grid at approximately 0207 MST on November 3, 1993.

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Figure omitted.

ATTACHMENT TO 9312090060 PAGE 1 OF 1

Arizona Public Service Company  
PALO VERDE NUCLEAR GENERATING STATION  
P.O. BOX 52034 o PHOENIX, ARIZONA 85072-2034

192-00870-JML/BAG/KR  
JAMES M. LEVINE November 25, 1993  
VICE PRESIDENT  
NUCLEAR PRODUCTION

U. S. Nuclear Regulatory Commission  
Attention: Document Control Desk

Mail Station P1-37  
Washington, D.C. 20555

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)  
Unit 2  
Docket No. STN 50-529 (License No. NPF-51)  
Licensee Event Report 93-004-00  
File: 93-020-404

Attached please find Licensee Event Report (LER) 93-004-00 prepared and submitted pursuant to 10CFR50.73. This LER reports a Unit 2 reactor trip on low steam generator water level following the loss of both main feedwater pumps (MFWPs), and resultant Engineered Safety Feature Actuation System (ESFAS) actuations of both Auxiliary Feedwater Actuation Systems (AFAS-1 and AFAS-2). The reactor trip was initiated by a non-Class 1E 4.16 kV switchgear bus load shed which caused the loss of two condensate pumps and a heater drain pump. Both MFWPs tripped on low suction pressure.

In accordance with 10CFR50.73(d), a copy of this LER is being forwarded to the Regional Administrator, NRC Region V. If you have any questions, please contact Burton A. Grabo, Supervisor, Nuclear Regulatory Affairs, at (602) 393-6492.

Sincerely,

JML/BAG/KR/rv

Attachment

cc: W. F. Conway (all with attachment)  
B. H. Faulkenberry  
J. A. Sloan  
INPO Records Center

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